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IS 9935 (2002): Power Tiller - Test Code [FAD 11: Agricultural Tractors and Power Tillers]

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भारतीय मानक

पावर टिलर — परीक्षण संहिता

(दूसरा पुनरीक्षण)

Indian Standard

POWER TILLER — TEST CODE

(Second Revision)

ICS 65.060.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 2002

Price Group 9

Agricultural Tractors and Power Tillers Sectional Committee, FAD 32

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Agricultural Tractors and Power Tillers Sectional Committee had been approved by the Food and Agriculture Division Council.

Power tillers are being increasingly used for mechanizing agricultural operations and the power tiller industry has developed as an important engineering industries in the country. The increase in the manufacture and use of power tillers has necessitated application of standardized tests for evaluation of their performance on a uniform and rationalized basis.

This standard was first published in 1981. On the basis of experience gained in testing of power tillers, it was revised in 1988. This standard is revised again to incorporate various modification suggested by testing authorities and aligning with IS 5994 : 1998 'Agricultural tractors — Test code'.

The composition of the Committee responsible for formulation of this standard is given in Annex J.

In reporting the result of a test, made in accordance with this standard if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

POWER TILLER — TEST CODE

(Second Revision)

1 SCOPE

This standard covers the terminology, general guidelines and tests to be conducted on power tillers. The standard also covers methodology for testing of air cleaner oil pullover, vibration and inspection of components/assemblies.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouaged to investigate the possibility of applying the most recent editions of the standards indicated.

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to those given in IS 9939 shall apply.

3.1 Commercial Test

The tests conducted for establishing performance characteristics of power tillers that are ready for commercial production or already in production.

3.1.1 *Initial Commercial Test*

The tests conducted on indigenous or imported prototype of power tiller ready for commercial production.

3.1.2 *Batch Test*

The tests conducted on power tillers which have already undergone initial commercial test and/or being manufactured commercially in the country.

3.2 Confidential Test

The tests conducted for providing confidential information on the performance of power tillers whether ready for commercial production or not, or to provide any special data that may be required by the manufacturer/applicant.

3.3 Maximum Engine Power

Maximum sustainable engine power available at the crankshaft.

3.4 Operational Mass

The mass of the power tiller in normal working condition with fuel tanks and radiator (if fitted) full and lubricants filled to the specified levels.

NOTE — Any accessory fitted and its mass should be stated.

3.5 Power Outlet

Any outlet through which the engine power of the power tiller can be transmitted for its utilization.

3.6 Power Tiller

A prime mover having single axle in which the direction of travel and its control for field operation is performed by the operator walking behind it. It is also known as hand or walking type tractor. Some of these may have riding arrangement.

3.6.1 *General Purpose Type*

The power tiller which can be used for a number of farm operations, including the types defined under pull type and tilling type.

3.6.2 *Pull Type*

The power tiller which pulls various kinds of implements.

3.6.3 *Tilling Type*

The power tiller which uses an engine power driven tilling device, such as rotary and crank or screw blades.

3.7 Rated Engine Power

The power available at the crankshaft or its equivalent at the rated speed specified by the manufacturer.

3.8 Tyre Rolling Radius

The effective radius corresponding to the average distance travelled by the power tiller in one rotation of the driving wheels (that is, this distance divided by 2π). When the power tiller is driven without drawbar load at a speed of approximately 2 km/h.

3.9 Wheel Slip (For Dry Land Operation)

This shall be determined by the following formula:

$$\text{Slip, percent} = \frac{100\,(N_1 - N_2)}{N_1}$$

Where

N_1 = Sum of revolutions of driving wheels for a given distance when the power tiller is driven under load, and

N_2 = Sum of revolutions of driving wheels for the same distance when the power tiller is driven without load at a speed approximately 2.0 km/h.

3.10 Travel Reduction (For Wet land Operation)

This shall be determined by the following formula:

$$TR = \frac{1000\,(D_1 - D_2)}{D_1}$$

Where

D_1 = distance travelled in metres at no load for 5 or 10 revolutions of wheel, and

D_2 = distance travelled in metres at load in 5 or 10 revolutions of wheel.

4 GENERAL GUIDELINES

4.1 Specification Sheet

The power tiller manufacturer/applicant shall supply the specification of the power tiller consisting of the items listed in the specimen report given in Annex B, as well as any other information required by the testing authority to carry out the tests. The manufacturer/applicant should also supply technical literature such as operational, maintenance and service manuals, and parts catalogue.

4.2 Conditions for Checking of Dimensions

4.2.1 The power tiller shall be without any wear on tyres and placed on a firm horizontal surface.

4.2.2 Unless otherwise stated by the manufacturer/applicant, the power tiller shall be stationary with its wheels and components in the positions they would be, if the power tiller was travelling in a straight line.

4.2.3 The pressure in pneumatic tyres shall be adjusted to the value recommended by the power tiller manufacturer for field work.

4.3 Selection

The power tiller, under production, should be selected at random (*see* IS 4905) from the production line complete with its standard accessories and in a condition as generally offered for sale. The power tiller shall be new and should not be given any special treatment or preparation for test. The method of selection should be reported in the proforma given in Annex C.

4.4 Running-In

The manufacturer/applicant shall run-in the power tiller before the test, under his responsibility and in accordance with his usual instructions. The running-in shall be carried out in collaboration with the testing authority. If this procedure is impracticable due to the power tiller being an imported model, the testing authority may itself run-in the power tiller in accordance with the procedure prescribed or agreed to with the manufacturer/applicant.

4.4.1 The place and duration of the running-in shall be reported in the proforma given in Annex C.

4.5 Servicing and Preliminary Setting After Running-In

4.5.1 After completion of running-in, servicing and preliminary settings should be done according to the printed literature supplied by the manufacturer/applicant. The following may be carried out, wherever applicable:

a) Change of the engine oil;
b) Change of air cleaner oil (if provided with an oil-bath type air cleaner);
c) Change of transmission oil;
d) Change of oil and fuel filters (if required);
e) Greasing/oiling of all the lubricating points;
f) Adjustment of valve clearance and injection pressure (if required);
g) Tightening the nuts and bolts;
h) Checking and adjusting the tension of belts and chains;
j) Checking and adjustment of safety devices, if any; and
k) Any other checking or adjustment recommended by the manufacturer after the running-in period, and included in the printed literature of the power tiller.

4.5.2 The manufacturer/applicant may make adjustments in fuel injection pump, governor, fuel injector and any other adjustments during the period the power tiller is prepared for tests. These adjustments should conform to the values specified by the manufacturer/applicant for agricultural use in the printed literature/specification sheet. No adjustment shall be made, unless it is recommended in the literature. All the parts replaced shall be reported in the test report.

NOTE — Adjustment of fuel injection pumps except for low/high idling speed shall not be permitted under commercial test.

4.6 Ballasting

The ballast mass, which are commercially available and approved by the manufacturer for use in agriculture, may be fitted. For wheeled power tillers, liquid ballast on each tyre including liquid ballast in the tyres, and the inflation pressures shall be within the limits specified by the tyre manufacturer or load limit of axle, whichever is lower. Measure inflation pressure with the tyre valve in the lowest position.

4.7 Repairs and Adjustments During Tests

All repairs and adjustments made during the tests shall be reported, together with comments on any practical defects or shortcomings in Annex C. This shall not include those maintenance jobs and adjustments which are performed in conformity with the manufacturer's recommendations.

4.8 Fuel and Lubricants

Fuel and lubricants for the tests shall conform to **5.3** of IS 12226.

4.9 Auxiliary Equipments

For all power tests, accessories/ auxiliary drives (if any) may be disconnected only if it is practicable to do so as a normal practice during work in accordance with the operator's manual without using any tool. If not, they shall remain connected and operate at minimum load.

4.10 Fuel Consumption

The fuel measurement apparatus shall be so arranged that the fuel pressure at the fuel transfer pump is equivalent to that which exists when the power tiller fuel tank is half full. The fuel temperature shall be comparable to that in the normal operation of the power tiller when fuel is taken from the power tiller fuel tank. Efforts shall be made to limit the temperature variations throughout the tests.

4.10.1 To obtain hourly fuel consumption by volume and the work performed per unit volume of fuel, conversion of unit of mass to unit of volume shall be made using the density value at 15°C.

4.10.2 When the fuel consumption is measured by volume, the specific fuel consumption shall be calculated using the density corresponding to the appropriate fuel temperature.

4.11 Atmospheric Conditions

4.11.1 *Atmospheric Pressure*

Minimum 96.6 kPa during laboratory tests. The pressure shall be noted at the beginning of the test.

4.11.2 *Temperature*

For power tests, the normal ambient temperature shall be 27 ± 7°C. The temperature for high ambient test shall be 43 ± 2°C.

Ambient air temperature at a representative point shall be measured as follows:

Approximately 2 m in front or side depending upon the location of suction or blower device of power tiller and approximately 1.5 m above the ground.

NOTE — No correction shall be made to the test results for atmospheric conditions.

5 MEASURING TOLERANCES

The measuring apparatus shall be such that the following items shall have the tolerances within the limits shown against each:

a) Rotational speeds, rev/min	± 0.5 percent
b) Time	± 0.2 s
c) Distance, m or mm	± 0.5 percent
d) Force, N and torque, N.m	± 1.0 percent
e) Mass, kg	± 0.5 percent
f) Atmospheric pressure, kPa	± 0.2
g) Tyre pressure, kPa	± 5 percent
h) Temperature of fuels etc, °C	± 2
j) Wet and dry bulb thermometers, °C	± 0.5
k) Fuel consumption (overall for the apparatus used);	
1) Engine test, kg	± 1.0 percent
2) Drawbar test, kg	± 2.0 percent

6 TESTS

Various tests to be conducted on an power tiller are given in Table 1. The implementing authority shall decide about the tests and their frequency to be carried out during initial commercial and batch testing (*see* **3.1** and **3.2**).

7 CHECKING OF SPECIFICATIONS

7.1 The information given by the manufacturer/ applicant in the specification sheet (*see* **4.1**) shall be verified by the testing authority and reported. Details of the components and assemblies which do not conform to the relevant Indian Standards shall also be reported. The adequacy or otherwise of the literature shall be indicated.

7.2 While checking the dimensions of the power tiller, the conditions laid down in **4.2** shall be followed.

8 ENGINE PERFORMANCE

8.1 Power Tests

8.1.1 *Natural Ambient Test*

The following tests on the engine as per IS 12036 shall be conducted.

8.1.1.1 *Maximum power test* — *see* **6.1.2** of IS 12036.

8.1.1.2 *Varying speed test at full load* — *see* **6.1.3** of IS 12036.

Table 1 Tests To Be Conducted on power Tiller

(*Clause* 6)

Sl No.	Tests	Method of Test, Ref to		Remarks
		Clause No. of this Standard	Other Standards	
(1)	(2)	(3)	(4)	(5)
i)	Checking of the specification	*see* 7		
ii)	Engine performance	*see* 8		
iii)	Rotary shaft test	*see* 9		To be conducted on tilling and general purpose power tillers
iv)	Drawbar performance	*see* 10		
v)	Turning ability	*see* 11		
vi)	Parking brake test	*see* 12		
vii)	Aircleaner oil pull-over test	*see* 13		
viii)	Smoke measurement		IS 12062	
ix)	Noise measurement			
	1) At operator's year level	see 15		
	2) At bystander position	see 15		
x)	Vibration measurement	*See* 14		
xi)	Safety		IS 12239 (Part3)	
xii)	Field performance and haulage test		IS 9980	
xiii)	Component/assembly inspection	*See* 15		
xiv)	Special characteristics	*See* 16		If required by the manufacturer and with the mutual agreement of manufacturer and testing authority

8.1.1.3 *Varying Loads Test — see* **6.1.4** of IS 12036.

8.1.1.4 *Five hour engine rating test*

This test shall be done when rotary attachment is not provided. The engine shall be run at 90 percent of load corresponding to maximum power continuously for 4 h. During the 5th hour, the engine shall be run at a load corresponding to maximum power. During the test, all the parameters specified in **6.1.7** of IS 12036 shall be recorded after every half-an-hour during the first 4 h and after every 15 minutes during the 5th hour.

NOTE — If the engine speed recommended for field tests is different from rated engine speed, then tests at the recommended setting shall also be conducted.

8.1.2 *High Ambient Test*

The following tests on the engine under high ambient temperature (43 ± 2°C) shall be conducted.

8.1.2.1 *Varying speed test*

This test shall be carried out in accordance with **6.1.3** of IS 12036.

8.1.2.2 *Maximum power test* (*see* **6.1.2** of IS 12036)

The coolant and lubricating oil consumption shall be recorded as under:

a) Coolant-percent of total coolant capacity, and
b) Lubricating oil - g/kW.h.

8.1.3 The data shall be recorded in **D-1**.

9 ROTARY SHAFT TEST

The following tests shall be conducted on rotary shaft at the lowest rotary shaft speed if more than one rotary shaft speed.

9.1 Normal Ambient Temperature Test

9.1.1 *Varying Speed Test*

This test shall be carried out in accordance with **6.1.3** of IS 12036.

9.1.2 *Five Hour Test at Rated Power of Rotary Shaft*

This test shall be carried out in accordance with **8.1.1.4**.

9:3 The data shall be recorded in **D-2**.

10 DRAWBAR PERFORMANCE

10.1 General

10.1.1 If the power tiller is fitted with pneumatic wheels, the test shall be conducted on a clean, horizontal and dry concrete test track containing a minimum number of joints. If the use of power tiller for field work is recommended with steel wheels, the test shall be conducted on flat, dry and horizontal mown or grazed grass land, or a horizontal surface having good adhesion characteristics.

NOTE — Type of track over which the drawbar test is conducted shall be stated in the test report.

10.1.2 During all the tests at drawbar, the governor control lever shall be placed in the position recommended for drawbar work by the manufacturer/applicant.

10.1.3 The test shall not be conducted in the gear for which the forward speed exceeds the safety limit of the testing equipment.

10.1.4 During the test, the line of pull shall be maintained horizontal. The height of the drawbar shall remain fixed in relation to the power tiller.

10.1.5 At the beginning of each test, the height of the tyre tread bars or lugs of the steel wheels shall not be less than 65% of their height when new. The measurement shall be made at the centre line of the tyres/steel wheel.

10.1.6 The measurement of drawbar pull, speed and slip shall be started only after the operational conditions are stabilized.

10.1.7 Each test shall, as far as possible, be conducted continuously without varying atmospheric or track conditions significantly.

10.2 Test for Maximum Power and Pull

During the test, the power tiller shall be in order to find the maximum power and pull in different forward speed gears. Measurement of fuel consumption, forward speed, wheel slip, temperature of engine oil, coolant, transmission oil and fuel shall be recorded for all the values of the pull. If the manufacturer/applicant recommends ballasting of the power tiller, the test shall be conducted both at ballasted and unballasted conditions of the power tiller and the results shall be reported separately.

10.3 Ten Hour Test

The power tiller shall be tested for 10 h in the gear designated by the manufacturer/applicant for field work in agreement with the testing station. The drawbar load applied shall be 75 percent of the pull at maximum power in the gear being used. Values of power, forward speed, slip and fuel consumption shall be recorded and reported.

10.4 The data shall be recorded in **D-3**.

11 TURNING ABILITY

11.1 General

11.1.1 The test area shall be a horizontal compacted or paved surface having good tyre adhesion and capable of displaying legible marking.

11.1.2 The power tiller shall be tested with all liquid reservoirs filled to the specified level but without ballast, mounted implements and any other specified components.

11.1.3 The test shall be conducted with the power tiller moving at the minimum attainable speed, measured at a point located on the mid point between the rear wheels.

11.1.4 The tyres shall be new and inflation pressure shall be maintained as recommended for the road work by the manufacturer.

11.2 Procedure

The test shall be carried out on the power tiller by turning it to the right and the left side by the use of steering clutch till a 360°C turn is completed. During the test the following shall be recorded:

a) Diameter of the minimum turning circle, and
b) Diameter of the minimum turning space required.

11.3 The data shall be recorded in **D-4**.

12 PARKING BRAKE TEST

12.1 The unballasted or ballasted power tiller shall be placed out of gear on a slope of 18 percent with the brakes applied. The power tiller shall be placed first facing up and then down the slope, the rotation of the braked wheel shall be observed. The observation along with the factors allowing the rotation of the wheels shall be stated in the test report.

12.2 The force, necessary to apply at the control of the parking braking device to hold a vehicle combination comprising the unballasted power tiller and an unbraked trailer of the same mass of the power tiller or 1 tonne whichever is less, stationary when facing up and down on 12 percent gradient, shall be measured.

12.3 The data shall be recorded in **D-5**.

13 AIR-CLEANER OIL PULL-OVER TEST

13.1 The power tiller shall be parked on a level ground. The air-cleaner shall be cleaned and filled up to a level of 5 percent (on mass basis) over the specified level with an oil of viscosity recommended by the manufacturer The engine shall then be operated at full governed speed for 15 minutes. This shall be followed by sudden accelerations and decelerations made after every 30 seconds for a period of 15 minutes. The air-cleaner assembly shall be weighed before and after the test. The loss of mass of oil, both in grams and in percentage of mass, shall be reported.

NOTE — Before starting the test, the engine shall be run for one hour.

13.1.1 The air-cleaner oil pull over test shall be carried out in the following positions:

a) In horizontal position;

b) In the case of wheeled power tillers, the tests shall be repeated with the power tiller tilted 15° to either side and then 15° forward and backward in relation to the direction of travel of the power tiller; and

c) In the case of crawler power tillers, the forward and backward tilt shall be 20°.

13.2 The data shall be recorded in accordance with Annex E.

14 VIBRATION MEASUREMENT

14.1 The amplitude of mechanical vibration of components/assemblies of the power tiller shall be measured with the help of suitable vibration measuring device on the components listed in Annex F.

14.2 The power tiller shall be parked on a level concrete surface and tyres inflated according to off-field pressure recommended for road work. The power tiller and its rotovator shall be operated at rated engine speed at no-load. The maximum horizontal displacement (HD) and vertical displacement (VD) in microns shall be measured by mounting the measuring device in related positions.

14.3 The data shall be recorded in accordance with Annex E.

15 NOISE MEASUREMENT

15.1 General

The measuring equipment meteorological conditions, ambient noise and test site for measuring the noise of power tiller shall be in accordance with IS 12180 (Part 1) and IS 12180 (Part 2).

15.2 Noise at By-Stander Position

The measurement of the noise of power tiller at by-stander position shall be conducted in accordance with IS 12180 (Part 1) except that:

a) the measurement shall be made with the power tiller stationary on a short grass or soil surface,

b) the engine of the power tiller shall be operating at the manufacturer's rated speed and all mechanisms shall be functioning as in normal field work. Tillage or moving components shall not engage with the soil or crop, and

c) the A-weighted sound pressure level and optionally octave band pressure level shall be measured and reported.

15.3 Noise at Operator's Ear Level

15.3.1 During the test, all the general conditions as specified in **15.1** shall remain the same.

15.3.2 The test shall be conducted at different drawbar loads in different forward speed gears. The drawbar loads shall be applied by the loading device remotely positioned to eliminate interference with the sound fields caused by the power tiller. For tilling type power tiller, the test shall be conducted with rotavator in operation under dry land conditions. The noise level at varying depths of operation shall be recorded and the maximum value reported.

15.3.3 During the measurement, the microphone shall be horizontal and facing forward. It shall be 5 cm to the side of the operator's forehead and in line with his eyebrows. It shall be mounted on an open frame helmet.

15.3.4 During the test, the governor control lever shall be in fully open position. Starting with no load, the load applied shall be increased until the maximum sound level is found. After each increase of load, time will be allowed for sound level to stabilize before taking the measurement.

15.3.5 The sound level measurements shall be made in all forward speed gears. The results shall be reported in the gear giving the nearest forward speed of 2km/h and also under any gear for which a sound level of at least 1 dB (A) above that of the above mentioned gear was recorded.

15.4 The data shall be recorded in Annex G.

16 COMPONENT/ASSEMBLY INSPECTION

16.1 The engine, transmission, parking brakes, axle, and generator shall be partially dismantled after conducting all the tests. The following measurement/ observations shall be made and reported.

16.1.1 *Cylinder Bore*

The cylinder bore shall be measured on the thrust side and perpendicular to it at the top, middle and at the bottom position of the liner.

16.1.2 *Piston Diameter*

The piston diameter shall be measured on the thrust side and perpendicular to it at the top above the gudgeon pin and at the skirt. The clearance between the piston and cylinder at the skirt shall be worked out from the measurements made on piston and cylinder liner. Clearance between the piston and cylinder at skirt shall be worked out from measurements made on piston and cylinder liner.

16.1.3 *Ring End Gap*

The ring end gap for all compression and oil rings shall be measured at the top, middle and bottom position of the liner.

16.1.4 *Ring Groove Clearance*

The ring groove clearance shall be measured for all compression and oil rings.

16.1.5 *Clearances of Main and Big End Bearing*

The radial and axial clearance of main and big end bearings shall be measured. The radial clearance shall be measured after tightening the crankshaft bolts with the torque specified by the manufacturer.

16.1.6 *Valves, Guides, and Timing Gear/Chain-Sprocket*

The valve shall be inspected for overheating signs and pitting of the seats. The timing gear cover shall be opened and the gears/sprockets inspected for damage/wear. Stiffness of spring and clearance between valve guide and valve stem shall be measured.

16.1.7 *Clutch*

The clutch shall be opened and inspected for condition of the clutch-release bearing, springs, and release levers. Clutch friction plate wear should be determined by measuring the thickness. The clutch housing shall be inspected for the entry of dust, mud, water and oil.

16.1.8 *Gear Box*

The top cover of the gear box shall be opened and inspected for visual damage to the gear teeth.

16.1.9 *Brakes*

The brake housing shall be opened and inspected for the entry of dust, mud, water and oil. The wear of brake lining shall be determined by measuring the thickness.

16.1.10 *Rotary Chain Case*

The chain case shall be opened and inspected for the entry of dust, mud, water and oil. The condition of bearing chains and sprockets shall also be examined.

16.1.11 *Starter, Motor and Generator*

These shall be dismantled and inspected for entry of dust, mud, water and oil. The condition of the bearings shall also be examined.

NOTE — The observations covered under **16.1.7** to **16.1.11** shall be made after cleaning, washing and greasing as recommended by the manufacturer in printed literature.

16.2 The data shall be recorded in Annex C

17 SPECIAL CHARACTERISTICS

Supplementary measurements to determine any special characteristics of the power tiller may be carried out depending on requirements.

18 REPORTING THE RESULTS

The test results of power tiller shall be reported on the basis of proforma included in various standards dealing with the testing of power tillers. While preparing the test report, the provisions of IS 13539 shall also be kept in view.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
4905 : 1968	Methods for random sampling
9980 : 1988	Guidelines for field performance and haulage test of power tillers (*first revision*)
9939 : 1981	Glossary of terms relating to agricultural tractors and power tillers
12036 : 1995	Agricultural tractors — Test procedures — Power tests for power take off (*first revision*)
12062 : 1987	Method for measurment of exhaust smoke emitted by agricultural tractors
12180 (Part 1) : 2000	Tractors and machinery for agriculture and forestry — Noise measurement — Method of test: Part 1 Noise at the operator's position — Survey method (*first revision*)
12180 (Part 2) : 2000	Tractors and machinery for agriculture and forestry — Noise measurement — Method of test: Part 2 Noise emitted when in motion (*first revision)*
12226 : 1995	Agricultural tractors — Power tests for drawbar — Test procedure (*first revision*)
12239 (Part 3) : 1988	Guide for safety and comfort of operator of agricultural tractors and power tillers : Part 3 Power tillers
13539 : 1992	Power tillers — Selected performance characteristics — Recommendations

ANNEX B

(*Clause* 4.1)

SPECIFICATION SHEET FOR POWER TILLERS

B-1 POWER TILLER

a) Name and address of the manufacturer
b) Name and address of the applicant for test
c) Make/Type/Model
d) Serial number
e) Year of manufacture

B-2 ENGINE

a) Type/Make/Model
b) Serial number
c) Engine speed (manufacturer's recommended setting)

Maximum Speed at No Load rev/min	*Low Idle Speed* rev/min	*Speed at Max Torque* rev/min	*Rated speed* rev/min		
			For Rotary Shaft Use	For Draw Bar Use	Others, if any
(1)	(2)	(3)	(4)	(5)	(6)

B-3 CYLINDERS AND CYLINDER HEAD

a) Number
b) Disposition
c) Bore/stroke, mm
d) Capacity, cm^3
e) Compression ratio
f) Type of cylinder head
g) Type of cylinder liners
h) Type of combustion chamber
j) Arrangement of valves
k) Valve clearance (hot/cold):
    1) Inlet valve
    2) Exhaust valve

B-4 FUEL SYSTEM

a) Type of fuel feed system
b) Fuel tank:
    1) Capacity, litres
    2) Location
    3) Provision for draining of sediments/water
c) Fuel filters:
    1) Make/Model/Type
    2) Number
    3) Capacity of final stage filter

d) Fuel injectors:
  1) Make/Model/Type
  2) Manufacturer's production setting (valve opening pressure), kPa

e) Injection timing

f) Magneto, coil and distributor
  — Make/Model/Type

g) Injection pump:
  1) Make/Model/Type
  2) Serial number
  3) Pump setting:

Adjustments	*Pump Shaft Speed*	*Number of Strokes*	*Metering and Tolerable Difference*		*Rate of Displacement*	*Remarks*
	rev/min		cm³	g		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rated value of fuel pump						
Low idle setting						
Full load setting						

B-5 GOVERNOR

a) Make/Model/Type

b) Governed range of engine speed, rev/min

c) Rated engine speed, rev/min

B-6 PRE-CLEANER

a) Make/Model/Type

b) Location of air intake

B-7 AIR CLEANER

a) Make/Model/Type

b) Location of air intake (in case of no pre-cleaner)

c) Oil capacity, l

d) Oil change period, h

B-8 EXHAUST

a) Type of silencer

b) Details of spark arresting device, if fitted

B-9 LUBRICATING SYSTEM

a) Type

b) Filters:
  1) Type
  2) Number

c) Oil sump capacity, l

d) Oil changing period, h

e) Pump:
  1) Type
  2) Capacity at rated speed, l/min (at .... °C)
  3) Pressure release setting, kPa
  4) Method of drive and cooling device (if any)
  5) Minimum lubrication oil pressure, kPa

B-10 COOLING SYSTEM

a) Type

b) Details of pump and fan

c) Capacity of pump in l/min at ... rev/min

d) Means of temperature control

e) Bare radiator capacity, l

f) Total coolant capacity, l

g) Pressure of radiator cap, kPa

h) Method of drive

B-11 ELECTRICAL SYSTEM

a) Generator:
  1) Make/Model/Type
  2) Serial number
  3) Output rating

b) Details of Lights

Description	*Height of Centre Above Ground*	*Size*	*Distance from Centre of the Beam to Outside Edge of Power Tiller at Standard Rear Track Setting*
	mm	mm	mm
(1)	(2)	(3)	(4)
Headlights			
Reflectors			

c) Details of other electrical accessories

B-12 INSTRUMENT PANEL DETAILS

B-13 TRANSMISSION SYSTEM

a) From crankshaft to the main shaft

b) From main clutch to the first shaft

c) From the first shaft to the wheel axle

d) From the first shaft to the rotary shaft

e) Clutch:
  1) Make/Type
  2) Size
  3) Number of friction plate
  4) Method of operation
  5) Friction plate:
    i) Type
    ii) Material

f) Steering clutch:
  1) Make/Type
  2) Size
  3) Number of friction plate
  4) Method of operation

g) Gear box:
  1) Make/Type
  2) Oil capacity, l
  3) Oil changing period, h
  4) Number of speeds:
    i) Forward
    ii) Reverse

5) Nominal speed :

Movement	*Gear Number*	*Number of Engine Revolutions for one Revolution of Driving Wheel or Sprocket*	*Nominal Speed at Rated Engine Speed When Fitted with .... Size Tyre, at an Inflation Pressure of ... and Rolling Radius of ...., km/h*
(1)	(2)	(3)	(4)
Forward	1		
	2		
	3		
	etc		
Reverse	1		
	2		
	etc		

h) Driving axle and final drive:
  1) Make/Type
  2) Differential lock:
    i) Type
    ii) Method of operation
  3) Reduction in final drive
  4) Oil capacity of final drive, l
  5) Oil changing period, h

j) Details of transmission if used other than those given in a), b) and c) above

B-14 ROTARY SHAFT

a) Location
b) Number of splines
c) Speed, rev/min
d) Size, mm
e) Height above ground, mm
f) Direction of rotation (viewed from driving end)
g) Rotary shaft speed at rated engine speed, rev/min
h) Power transmission system:
  1) Sprocket and chain
  2) Any other
j) Arrangement for fitting of tines on the shaft
k) Number and type of tines:
  1) Standard
  2) With extension
m) Details of other shafts, if any

B-15 MAIN PULLEY

a) Make/Type
b) Diameter, mm
c) Location
d) Reduction ratio (from engine to clutch)
e) Rotational speed at rated speed (rev/min) .... of engine, rev/min
f) Direction of rotation

B-16 HITCH

a) Type
b) Location
c) Height above ground level, mm
  1) Maximum
  2) Minimum
d) Method of changing height (if any)
e) Standard to which it conform

B-17 PARKING BRAKES

a) Make/Type
b) Method of operation

B-18 WHEEL EQUIPMENT

a) Tyres:
  1) Make
  2) Number
  3) Size
  4) Type of tyre
  5) Ply rating
  6) Maximum permissible loading capacity of each tyre at...kPa pressure
  7) Recommended inflation pressure, kPa
    i) For field work
    ii) For transport
  8) Track width, mm
  9) Method of changing track width, range and number of steps
  10) Method of changing track width, if any, and range
b) Steel wheel:
  1) Track width, mm
  2) Type
  3) Size:
    i) Diameter, mm
    ii) Width, mm
  4) Mass, kg

B-19 SEAT (IF PROVIDED)

a) Make/Type
b) Type of suspension
c) Type of damping
d) Range of adjustment (if any), mm

B-20 BALLAST

Sl No.	*Particulars*	*Blast Mass as Used, kg*	
		Water	Cast Iron Weight on Wheel
(1)	(2)	(3)	(4)
i)	During drawbar performance test		
ii)	During field performance test: a) Dry land b) Wet land		
iii)	During haulage test		

B-21 MASS OF POWER TILLER (WITHOUT DRIVER BUT WITH LUBRICANT, FUEL AND COOLANT FULL)

Condition	*Mass of Power Tiller*, kg
Without ballast	
With ballast:	
i) During drawbar performance test	
ii) During field performance test	
iii) During haulage test	

B-22 OVERALL DIMENSIONS

Condition (1)	*Length* (2)	*Width* (3)	*Height*, mm (4)	*Ground* (5)
Without ballast				

B-23 FUEL AND LUBRICANTS RECOMMENDED

a) Fuel:
  1) Type
  2) Grade
  3) Specific gravity at 15°C
  4) Viscosity
  5) Octane or cetane number
  6) Standard to which it conforms

b) Lubricants:

Sl No. (1)	*Location* (2)	*Type* (3)	*Grade* (4)
i)	Engine		
ii)	Air cleaner		
iii)	Transmission and rotary chain case		

c) Number of external lubricating points:
  1) Oiling
  2) Greasing

B-24 RECOMMENDED THROTTLE SETTING

a) For field operation:
  1) Dry land
  2) Wet land

b) For stationary work

c) Puddling

d) Haulage

B-25 STEERING HANDLE

a) Number
b) Material
c) Diameter of pipe
d) Length of grip
e) Material of grip
f) Diameter of grip
g) Distance of hand grip from the wheel axle in radial direction
h) Vertical adjustment

B-26 ADDITIONAL INFORMATION

a) Whether the power tiller is suitable for:
  1) Stationary work and if so maximum power rating
  2) Puddling (if suitable for puddling indicate features, such as water sealing, etc, provided)

c) Standard accessories and fittings

d) Optional accessories and fittings

e) Safety features, if any

f) Any special feature of the power tiller

NOTES

1 Delete the items not applicable to a power tiller.

2 Add any additional details, of the power tillers, if present.

3 Conformity or otherwise of a component, assembly or item with the relevant Indian Standard should be stated, wherever applicable.

ANNEX C

(*Clauses* 4.3, 4.4.1 *and* 4.7)

PROFORMA FOR SELECTION, RUNNING-IN AND REPAIRS

C-1 NAME OF THE MANUFACTURER

C-2 ADDRESS

C-3 SUBMITTED FOR TEST BY

C-4 SELECTED BY

C-5 METHOD OF SELECTION

C-6 PLACE OF RUNNING-IN

C-7 DURATION AND SCHEDULE OF RUNNING-IN

C-8 REPAIRS AND ADJUSTMENTS MADE DURING RUNNING-IN

C-9 NO. OF SEALING

C-10 LOCATION OF SEALING

ANNEX D

(*Clauses* 8.1.3, 9.3, 10.4, 11.3 *and* 12.3)

DATA SHEET FOR LABORATORY AND TRACK TESTS OF POWER TILLER

D-1 POWER TEST

a) Date and place of test :
b) Type of dynamometer used :
c) Fuel used: :
  1) Type :
  2) Density at 15°C :
d) Engine oil used: :
  1) Type :
  2) Grade :
e) Transmission oil used :
f) No load maximum engine speed, rev/min :
g) Engine oil consumption during 2 h maximum power test under high ambient conditions, g/kWh :
h) Engine performance test data : sheet given in **D-6** :

D-2 ROTARY SHAFT TEST

a) Date and place of test :
b) Type of dynamometer used :
c) Fuel used :
  1) Type :
  2) Density at 15°C :
d) Engine oil used:
  1) Type :
  2) Grade :
e) Transmission oil used :
f) No load maximum engine speed, rev/min :
g) Engine oil consumption : during rating test in kg/h under high ambient conditions
h) Engine performance test data : sheet given in **D-7**

D-3 DRAWBAR PERFORMANCE TEST

a) Date and location of tests :
b) Type of track :
c) Position of governor control lever :
d) Height of drawbar above ground :
  1) Power tiller with ballast :
  2) Power tiller without ballast :
e) Mass of power tiller :
  1) With ballast :
  2) Without ballast :
f) Type and size of tyres :
g) Tyre pressure, kPa :
h) Fuel used :
  1) Type :
  2) Density at 15°C :
  3) Calorific value :
  4) Distillation range :
j) Engine oil used :
  1) Type :
  2) Viscosity at 98.9°C
k) Transmission oil used :
  1) Type :
  2) Viscosity at 98.9°C :
m) Test data (*see* **D-8**)
n) Total oil consumption during 10 h test given under (m), kg/h :

D-4 TURNING ABILITY

a) Details of wheel equipment :
b) Wheel track, mm :
c) Size and pressure of tyres :
d) Test data :

Description	*Minimum Turning Diameter*		*Minimum turning Space Diameter*	
	Right Hand, Side, m	Left Hand, Side, m	Right Hand, Side, m	Left Hand, Side, m
1	2	3	4	5
With Steering Clutch				

D-5 PARKING BRAKE TEST

Power tiller mass :

Test observations

Observations (1)	*12 percent Slope Parking Braking Device Facing up Slope* (2)	*Parking Braking Device Facing Down Slope* (3)
Parking device control force (N)		
Whether rolling of braking wheels noticed	Yes/No	Yes/No
Efficacy of brakes		

D-6 ENGINE PERFORMANCE TEST DATA SHEET

Sl No.	*Test Condition*	*Tests*	*Break Power*	*Crank Shaft Torque*	*Engine Speed*	*Fuel Consumption*		*Specific Energy*	*Temperature,* °C					*Pressure,* kPa			*Atmospheric Conditions*		
			kW	N-m	rpm	Hourly g/h	Specific g/kWh	kWh/l	Fuel	Engine oil	Exhaust	Intake Air	Coolant	Intake Air	Exhaust Gas	Lub Oil	Temp °C	Relative Humidity %	Pressure kPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
i)	Normal ambient test	Maximum Power test i) Maximum power absolute ii) Maximum power at rated engine speed																	
	-do-	Varying engine speed at full load: i) ii) iii) etc																	
	-do-	Rated engine speed with varying load: i) ii) iii) etc																	
	-do-	Five hours engine rating test a) At load corresponding to 90% of maximum power (4 hour); i) ii) iii) etc																	

Sl No	*Test Condition*	*Tests*	*Break Power*	*Crank Shaft Torque*	*Engine Speed*	*Fuel Consumption*		*Specific Energy*	*Temperature, °C*					*Pressure, kPa*			*Atmospheric Conditions*		
			kW	N-m	rpm	Hourly g/h	Specific g/kWh	kWh/l	Fuel	Engine oil	Exhaust	Intake Air	Coolant	Intake air	Exhaust Gas	Lub Oil	Temp °C	Relative Humidity %	Pressure kPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
		b) At load corresponding to maximum power: i) ii) iii) etc																	
ii)	High ambient test	Varying speed at full load i) ii) iii) etc																	
	-do-	Maximum power test — Maximum power test absolute i) ii) iii)																	

D-7 ROTARY SHAFTPERFORMANCE TEST DATA SHEET

Sl No.	*Test Condition*	*Tests*	*Rotary Shaft Power*	*Rotary Shaft Torque*	*Engine Speed*	*Fuel Consumption*		*Specific Energy*	*Temperature, °C*					*Pressure,* kPa			*Atmospheric Conditions*			*Rotary Shaft Chain Speed*	*Rotary Shaft Oil Temp*
			kW	N-m	rpm	Hourly g/h	Specific g/kWh	KWhl	Fuel	Engine Oil	Exhaust	Intake Air	Coolant	Intake Air	Exhaust Gas	Lub Oil	Temp °C	Relative Humidity %	Pressure kPa	rpm	°C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
i)	Normal ambient test	Varying engine speed at full load i) ii) iii) etc																			
	-do-	Five hours test at rated power of rotary shaft a) At load corresponding to 90% of maximum power (4 hour): i) ii) iii) etc b) At load corresponding to maximum power i) ii) iii) etc																			
ii)	High ambient test	Two hour test at rated power of rotary shaft																			

D-8 TEST DATA DRAWBAR PERFORMANCE TEST

Sl No.	*Test*	*Gear Number Used*	*Travel Speed*	*Drawer Power*	*Corresponding Drawbar Pull*	*Engine Speed*	*Wheel or Track Slip*	*Fuel Consumption*			*Atmospheric Conditions*			*Temperature*, °C				*Maximum Sustained Pull*
											Temperature	Pressure	Relative Humidity	Fuel	Transmission Oil	Coolant	Engine Oil	
			km/h	kW	kN	rpm	%	kg/kWh	l/h	kWh/l	°C	kPa	%					KN
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
i)	**Maximum power test (ballasted)** i) ii) iii)																	
ii)	**Ten hour test at 75% of pull obtained at maximum power** i) ii) iii)																	
iii)	**Maximum power test (power tiller un-blasted)** i) ii) iii)																	

ANNEX E

(*Clauses* 13.2 *and* 14.3)

AIR-CLEANER OIL PULL-OVER TEST

E-1 TYPE OF OIL USED

E-2 ATMOSPHERIC CONDITIONS

a) Temperature, °C

b) Pressure, kPA

c) Relative humidity, percent)

E-3 MASS OF OIL BEFORE TEST (With 5% Excess on Mass Basis)

E-4 TEST DATA

Sl No. (1)	*Position of Power Tiller* (2)	*Starting Time* (3)	*Stopping Time* (4)	*Before Test* g (5)	*After Test* g (6)	*Loss of Oil* g (7)	*Loss*[1] *of Oil* (%) (8)	*Oil Pressure* kPa (9)	*Remarks* (10)
i)	Power tiller parked on level ground								
ii)	Power tiller tilted to 15° laterally on right hand side								
iii)	Power tiller tilted to 15° laterally on left hand side								
iv)	Power tiller tilted to 15° or 20° longitudinally with front end up								
v)	Power tiller tilted to 15° or 20° longitudinally with rear end up								

[1] Percentage of Loss = $\frac{\text{Loss of oil, g}}{\text{mass of oil before test, g}} \times 100$

ANNEX F

(*Clause* 14.1)

VIBRATION MEASUREMENT

F-1 DATE AND LOCATION OF TEST

F-2 TYPE OF ACCELEROMETER

F-3 TEST DATA

Sl No.	*Measuring Points*	*Vibration at No-load* microns	
		HD	VD
(1)	(2)	(3)	(4)
i)	Steering handle		
	Right		
	Left		
ii)	Rotovator speed gear lever		
iii)	Tail wheel adjustment handle		
iv)	Clutch/brake lever		
v)	Fuel tank top		
vi)	Air cleaner top		
vii)	Fender assembly		
	Right		
	Left		
viii)	Chain drive cover centre		
ix)	Air intake pipe		
x)	Fuel tank top lid		
xi)	Fuel filter		
xii)	Gear shifting lever		
xiii)	Accelerator lever		
xiv)	Radiator cap		
xv)	Operator's seat		
	Back		
	Bottom		
xvi)	Engine bonet		
	Front		
	Middle		
	Rear		

ANNEX G

(*Clauses* 15.4 *and* 16.2)

DATA SHEET FOR NOISE MEASUREMENT

G-1 AT OPERATOR'S EAR LEVEL

G-1.1 Brief Description of the Silencing System

G-1.2 Background Noise Level:

G-1.3 Detail of the Test Site:

G-1.4 Type of Sound Level Meter:

G-1.5 Type of Octave Filter and Frequency Analyzer, if Used :

G-1.6 Date of Test :

G-1.7 Atmospheric Conditions:

a) Temperature, °C
b) Pressure, kPa
c) Relative humidity, percent

G-1.8 Test Data

Sl No.	*Gear Used*	*Travelling Speed* km/h	*Sound Level* dB	 Sones
(1)	(2)	(3)	(4)	(5)

G-2 AT BY-STANDER'S POSITION

G-2.1 Brief Description of the Silencing System :

G-2.2 Background Noise Level:

G-2.3 Detail of the Test Site:

G-2.4 Type of Sound Level Meter:

G-2.5 Date of Test:

G-2.6 Atmospheric Conditions

a) Temperature, °C
b) Pressure, kPa
c) Relative humidity, percent

G-2.7 Test Data

Sl No.	*Gear Used*	*Travelling Speed,* km/h	*Sound Level* dB(A)	 Sones
(1)	(2)	(3)	(4)	(5)

Testing Engineer

ANNEX H

(*Clause* 16.2)

DATA SHEET FOR COMPONENT/ASSEMBLY INSPECTION

H-1 CYLINDER BORE DIAMETER

Cylinder No.	*Position*	*Measured Diameter After Test*		*Maximum Permissible Diameter*
		Thrust Side mm	Perpendicular to Thrust Side mm	mm
(1)	(2)	(3)	(4)	(5)
1	Top			
	Middle			
	Bottom			
etc				

H-2 PISTON

Piston No.	*Piston diameter (mm)*				*Play between Piston and Cylinder Liner at the Skirt of the Piston* (mm)	
	Top (above Compression Ring)		At Skirt			
	Thrust Side	Non-Thrust Side	Thrust Side	Non-Thrust Side	As Measured	Max Premissible limit

H-3 RINGEND GAP

Type of Ring	*Cylinder No.*	*Ring No.* mm	*Measured Clearance* mm	*Maximum Permissible Clearance* mm
(1)	(2)	(3)	(4)	(5)
Compression				
	1	1		
		2		
		3		
		etc		
	etc			
Oil				
	1	1		
		2		
		3		
		etc		

H-4 RING GROOVE CLEARANCE

Type of Ring	*Cylinder No.*	*Ring No.*	*Measured Clearance* mm	*Maximum Permissible Clearance* mm
(1)	(2)	(3)	(4)	(5)
Compression				
	1	1		
		2		
		3		
		etc		
	etc			
Oil				
	1	1		
		2		
		3		
		etc		
	etc			

H-5 RADIAL AND AXIAL CLEARANCE OF CRANKCASE BEARINGS

Bearing No.	*Type of Clearance*	*Measured Clearance After Test* mm	*Maximum Permissible Clearance* mm
(1)	(2)	(3)	(4)
1	Radial		
	Axial		
etc			

H-6 VALVES, GUIDES, TAPPETS AND TIMING GEAR

a) Any marked sign of over-heating;

b) Pitting of seat;

c) Any damage to the teeth of timing gear;

d) Spring stiffness, N/mm (kgf/mm); and

e) Clearance between valve guide and valve stem, mm.

H-7 CLUTCH

a) Any marked wear in clutch friction plate,

b) Condition of clutch release bearings,

c) Condition of pilot bearing,

d) Condition of springs and fingers,

e) Presence of oil and water in clutch housing, and

f) Thickness of clutch plate.

H-8 BRAKE

Type of Brake	*Initial Thickness of Brake Lining* mm	*Measured Thickness of Lining After Test* mm	*Minimum Permissible Thickness* mm
(1)	(2)	(3)	(4)
Left			
Right			

H-9 GEARBOX (ANY DAMAGE, PITTING AND CHIPPING OF THE GEAR TEETH)

H-10 ROTARY CHAIN CASE

a) Presence of oil and water in rotary chain case, and

b) Condition of rollers and chains.

H-11 GENERATOR

a) Presence of oil and water in generator housing, and

b) Condition of bearings.

ANNEX J

(Foreword)

COMMITTEE COMPOSITION

Agricultural Tractors and Power Tillers Sectional Committee, FAD 32

Organization	*Representative(s)*
Indian Agricultural Research Institute, New Delhi	Dr J. S Panwar (***Chairman***)
Bajaj Tempo Limited, Pune	Shri G. Venkatramanan Shri V. N. Mundada (*Alternate*)
Bengal Tools Limited, Kolkata	Shri K. L. Agarwal Shri Amitava Guin (*Alternate*)
Department of Agri Engg, Government of Tamil Nadu, Chennai	Chief Engineer (Agril. Engg) Supd Engineer (Land Development) (*Alternate*)
Central Farm Machinery Training and Testing Institute, Budni	Director Senior Test Engineer (*Alternate*)
Central Institute of Agricultural Engineering, Bhopal	Director Dr A. C. Varshney (*Alternate*)
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Northern Region Farm Mancinery Training & Testing Institute, Hissar	Director Senior Test Engineer (*Alternate*)
Punjab Agricultural University, Ludhiana	Dr S. S. Ahuja Dr Gursaheb Singh Manes (*Alternate*)
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Same Greaves Limited, Ranipet	Shri Vivek Gupta
Southern Region Farm Machinery Training and Testing Institute, Anantapur	Director Senior Test Engineer (*Alternate*)

(Continued on page 21)

(*Continued from page* 20)

Organization	*Representative(s)*
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BIS Directorate General	SHRI P. K. SARKAR, Director & Head (Food & Agri) [Representing Director General (*Ex-officio*)]

Member-Secretary
SHRI S. K. SINGH
Assistant Director (Food & Agri), BIS

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